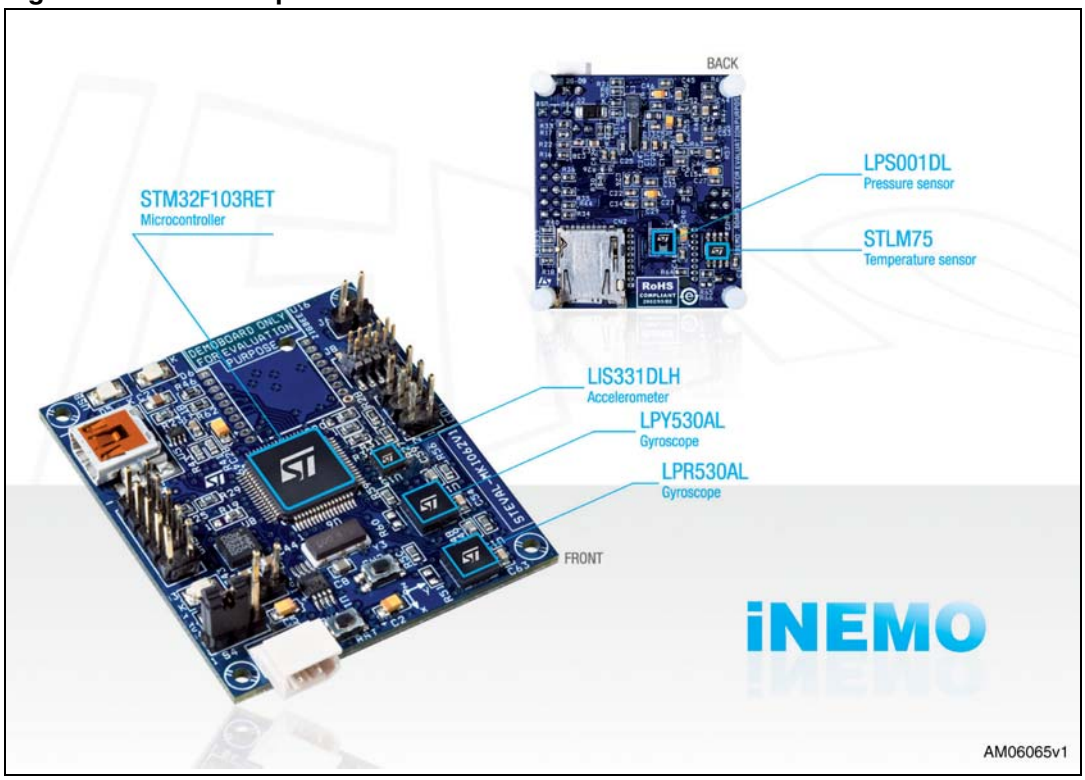
# AN3138
# Application note

## Wrapper in MATLAB for the STEVAL-MKI062V1

## Introduction

This application note provides information on the use of the application programming interface (API) of the iNEMO™ software development kit (SDK), which provides easy-to-use function calls to obtain data from the sensors or to change settings. The dynamic link library (DLL) object handles the hardware communication interfacing and is an easy way to achieve (soft) real-time performance. Typically, this is preferred when you want to access the iNEMO board (STEVAL-MKI062V1) capabilities directly in the MathWorks™ MATLAB® application software.

**Figure 1. iNemo™ platform**



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# 1 Getting started

## 1.1 Power-up

The STEVAL-MKI062V1 board can be supplied by USB. Before connecting the board to a USB port, configure switch S4 as described in the user manual of the board (UM0752).

The STEVAL-MKI062V1 software must be pre-installed on the computer before to using the MATLAB script described in this application note.

## 1.2 MATLAB version

MathWorks MATLAB 7.8 (release R2009a and higher) is compatible with the iNEMO SDK object. Older versions have not been tested.

# 2 Application code

## 2.1 Package description

Example codes are provided in the subfolder:

\STMicroelectronics\iNEMO Application\Redist

(the folder name could be different on your computer)

This subfolder contains:

- iNEMO_SDK.chm
  - help file for the software development kit
- iNEMO_SDK.dll
  - dynamic link library for the SDK
- iNEMO_SDL.h
  - header file for the iNEMO SDK dll
- iNEMO_SDK_Wrapper.cs
  - wrapper file in C#
- PL_001.dll - PL_001
  - dynamic link library
- iNEMO_easy_script.m
  - MATLAB example (included in *Appendix A*)

The iNEMO_easy_script.m file contains all the step-by-step instructions needed to use the iNEMO SDK API in MATLAB. The explanations in the sections that follow may be used as a guide for this file.

## 2.2 Generic MATLAB script usage

To load the dynamic link library within MATLAB, the load library instruction must be used with the syntax:

```
[notfound, warnings] = loadlibrary('shrlib', 'hfile')
```

where the hfile and shrlib are the filenames of the DLL and header files, respectively (names are case-sensitive). The name used in the load library must be in the same case as the file on your system. In the present case:

```
[notfound, warnings] = loadlibrary('iNEMO_SDK.dll', 'iNEMO_SDK.h');
```

Once the iNEMO_SDK object is loaded, its functions can be listed easily with the instructions:

```
libfunctions('iNEMO_SDK')
```

or

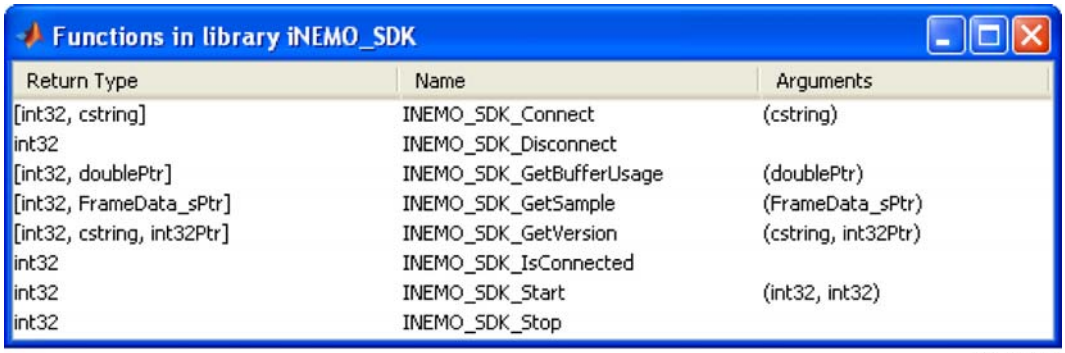
```
libfunctionsview('iNEMO_SDK')
```

Using one of these functions, the MATLAB displays the window in *Figure 2* with all the available functions that can be executed by using the calllib function:

```
[ret_1, …] = calllib('iNEMO_SDK', function_name, arg_1, arg_2, …);
```

The function_name (case-sensitive) should be one of the functions listed in *Figure 2*. arg_n are the arguments of the functions, and ret_n are the function results.

**Figure 2. Window displaying accessible functions**




Finally, to release the iNEMO_SDK from the MATLAB environment, the following function call must be used:

```
Unloadlibrary('iNEMO_SDK')
```

*Note: Improper use of function sequence calls may cause MATLAB to release the object incorrectly, resulting in error messages or unexpected behavior of the MATLAB environment. Shutting down MATLAB will always release the iNEMO_SDK object. Moreover, to restart the iNEMO board in the initial state, it is recommended to disconnect and then reconnect the board.*

## 2.3 Main functions

The iNEMO software development kit (SDK) allows implementation of the following actions:

- Connect the iNEMO board (STEVAL-MKI062V1) through USB virtual COM
- Start data acquisition
- Acquire data
- Stop acquisition
- Disconnect the iNEMO board

### 2.3.1 Connect

Once the iNEMO_SDK library is loaded, the first instruction to be used is:

```
calllib('iNEMO_SDK', 'INEMO_SDK_Connect', sCOM);
```

where sCOM should be a string in the format 'PL_001:COMx, BD115200'. COMx indicates the virtual COM port used by the iNEMO_SDK.

To identify which virtual COM port has been assigned by the PC to the iNEMO board, follow these steps:

1. On the desktop, right-click the My Computer icon and click on Manage (see *Figure 3*).
2. In Computer Management window, double-click on System Tools and then Device Manager to view all the hardware devices installed on the PC.
3. In the right pane, click the “+” sign next to Ports (COM & LPT) to view the list of available ports. In the list, the STEVAL-MKI062V1 iNEMO Platform (COMx) string should appear (see *Figure 4*).

The string contains the number of the COM port used by the board. This number should be used in the parameter string 'PL_001:COMx, BD115200' of the INEMO_SDK_Connect function. In the case shown in *Figure 4*, the parameter string is 'PL_001:COM23, BD115200'.

**Figure 3. First step: identifying the COM port used by the iNEMO board**

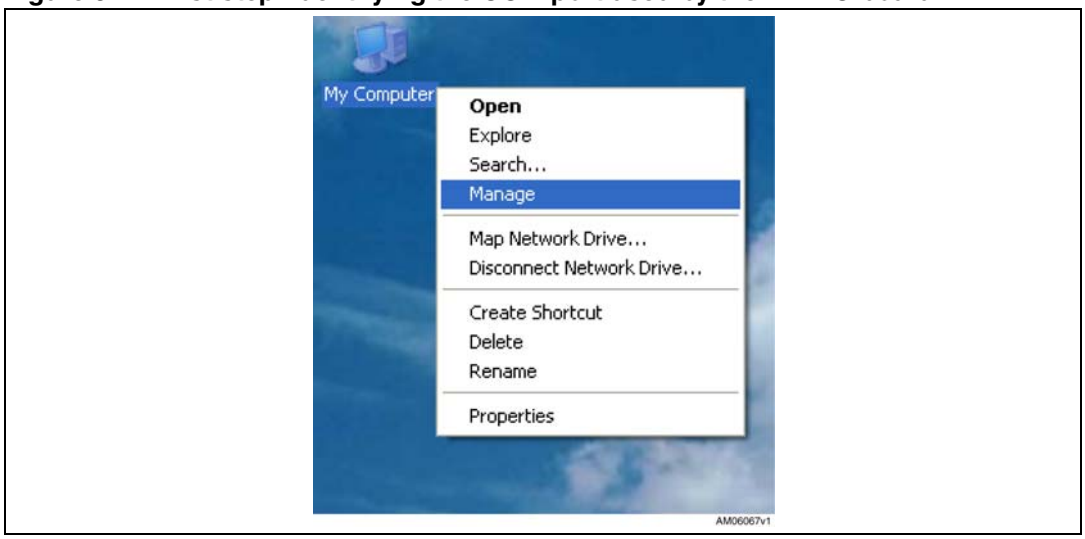
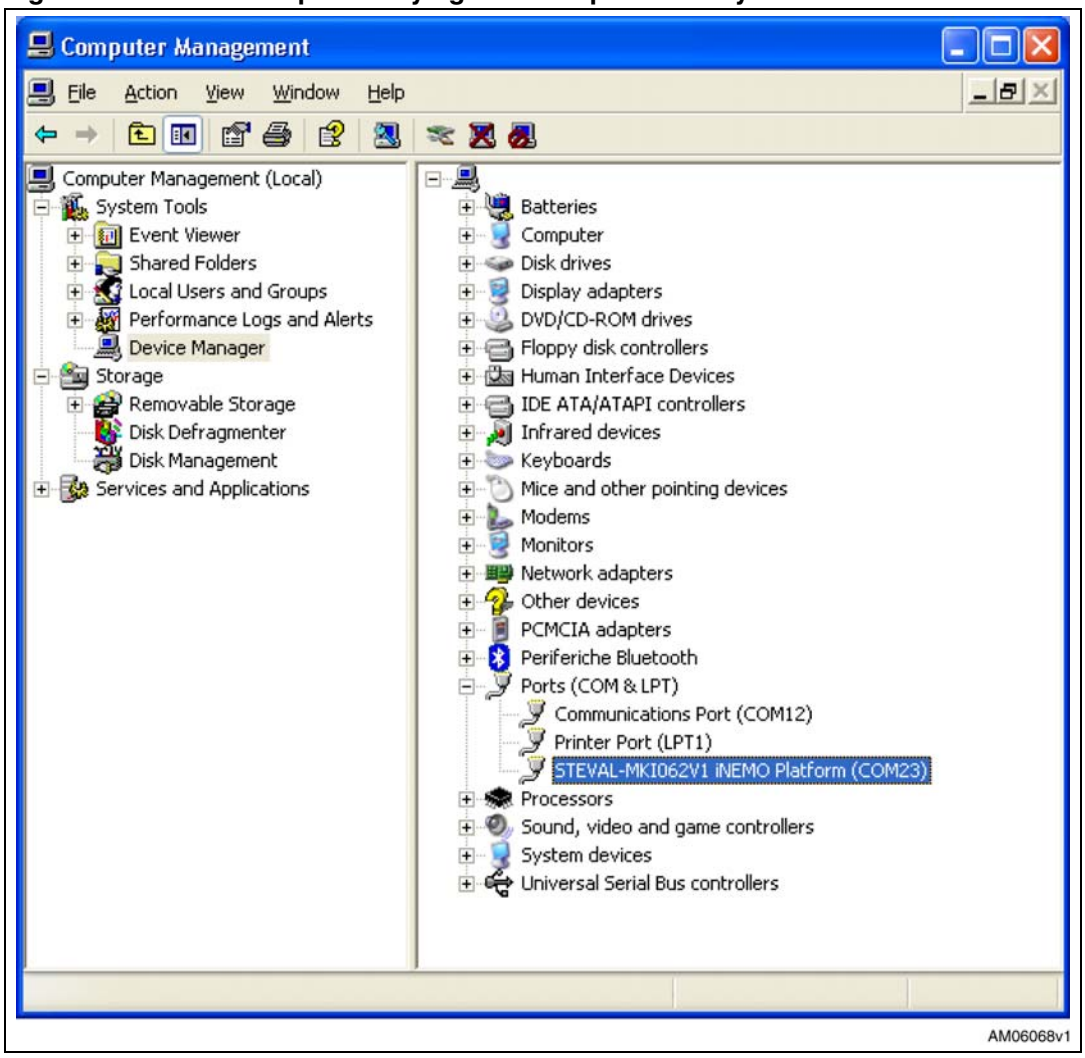


**Figure 4. Second step: identifying the COM port used by iNEMO board**




## 2.3.2 Start data acquisition

The sensor data acquisition phase starts using this function:

```
calllib('iNEMO_SDK','INEMO_SDK_Start', nFreq, nSamples);
```

where nFreq is the acquisition frequency (Hz), and nSamples is the number of samples to be received. If the latter is 0, the iNEMO board sends data in infinite loop mode until an INEMO_SDK_Stop command is received (*Figure 5*), otherwise the board sends only a finite number of samples indicated in the nSamples parameter (*Figure 6*).

The nFreq parameter accepts the values 1, 10, 25 or 50, while the nSamples parameter accepts values in the range 0 - 65535. As described above, this parameter is also used to choose the acquisition mode.

**Figure 5. Finite loop mode algorithm**

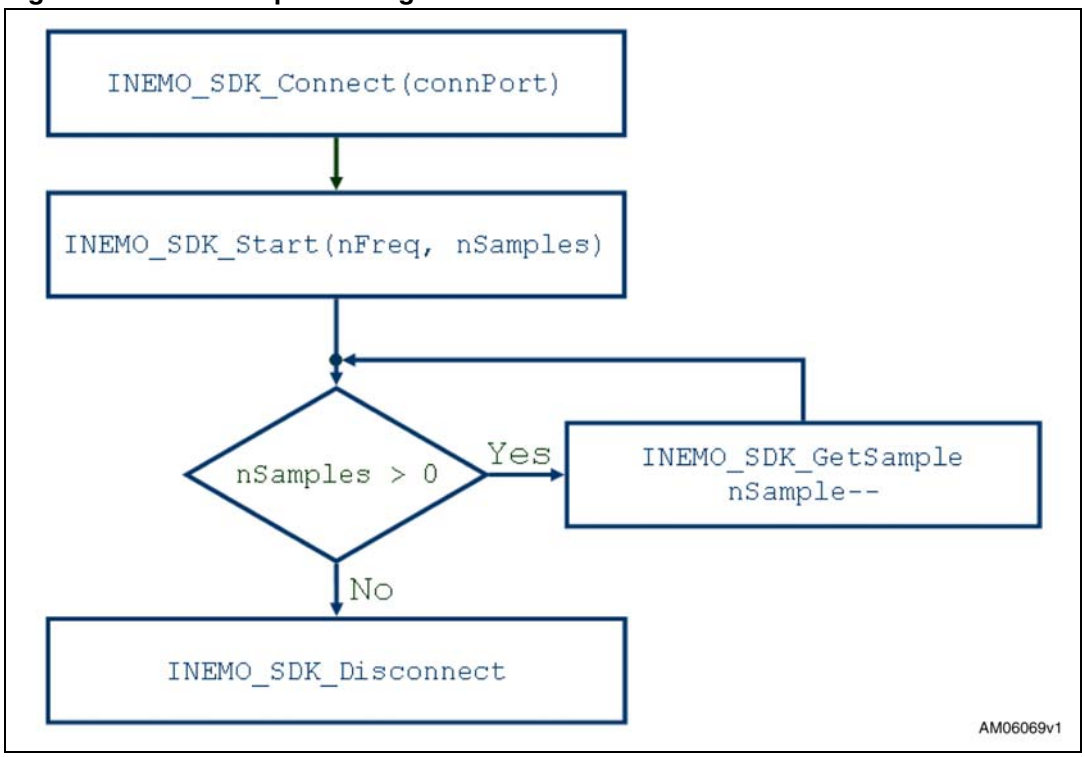
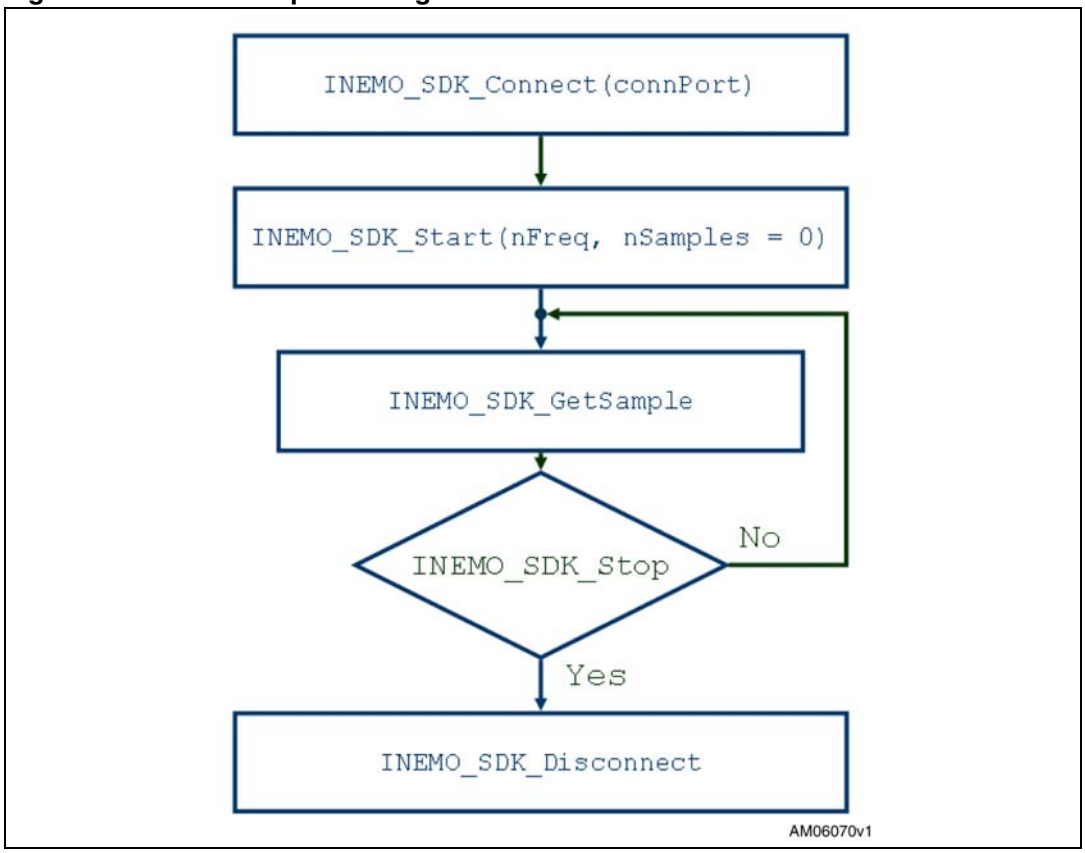



**Figure 6. Infinite loop mode algorithm**



### 2.3.3 Acquire data

The'INEMO_SDK_Start' instruction starts an internal process of the dynamic link library which collects the data from the iNEMO board in a FIFO (first-input, first-output) list. To obtain the data from this list the following instruction must be used:

```
[i32, pFD] = calllib('iNEMO_SDK', 'INEMO_SDK_GetSample', pFD);
```

where pFD is a C-language structure is organized as follows:

```
typedef struct
{
 SampleTimeStamp // timestamp (milliseconds from start)
 Accelerometer   // Accelerometer component (X, Y, Z) in mg unit
 Gyroscope       // Gyroscope component (X, Y1, Y2, Z) in dps unit
 Magnetometer    // Magnetometer component (X, Y, Z) in mGa unit
 Pressure        // Pressure value in 1/10 of mbar unit
 Temperature     // Temperature value in 1/10 of ºC unit
}
```

*Note: The FIFO filling is dictated by the frequency indicated in the nFreq parameter, since the use of the INEMO_SDK_GetSample instruction must be in accordance with this frequency. Otherwise, a faster INEMO_SDK_GetSample returns an empty pFD structure and a too-slow INEMO_SDK_GetSample returns too-old values.*

To verify the effectiveness of the pFD structure, it is recommended to check the returned value i32, which could be:

```
0 INEMO_SDK_ERROR_NONE = No error
4 INEMO_SDK_ERROR_STACK_EMPTY = The stack of data is empty
```

### 2.3.4 Stop acquisition

To stop the data acquisition process, use this instruction:

```
calllib('iNEMO_SDK', 'iNEMO_SDK_Stop');
```

This instruction does not delete the FIFO data, since the acquired data are still available to be viewed or processed.

Finally, to correctly detach the virtual COM port used on the USB link, is recommended to use the disconnect instruction:

```
calllib('iNEMO_SDK', 'INEMO_SDK_Disconnect')
```

*Section Appendix A: MATLAB script code* contains the MATLAB script code.

# 3 References and related materials

The following additional information for the STEVAL-MKI062V1 is available on www.st.com:

- STEVAL-MKI062V1 data brief
- User manual UM0752: STEVAL-MKI062V1, iNEMO: iNErtial MOtion demonstration board based on the MEMS devices and STM32F103Rx

# Appendix A MATLAB script code

```
% ************* (C) COPYRIGHT 2009 STMicroelectronics *************
% File Name          : iNEMO_easy_script.m
% Author             : IMS SYSTEMS LAB - ART TEAM
% Version            : V 1.0
% Date               : 10/27/2009
% Description        : iNEMO Demo file for Matlab
%
*******************************************************************
% THE PRESENT FIRMWARE WHICH IS FOR GUIDANCE ONLY AIMS AT PROVIDING
CUSTOMERS
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TO SAVE TIME.
% AS A RESULT, STMICROELECTRONICS SHALL NOT BE HELD LIABLE FOR ANY
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FILE LOCATED
% IN THE ROOT DIRECTORY OF THIS FIRMWARE PACKAGE.
%
*******************************************************************
% Further Note:
%
%  This script has been tested with Mathworks Matlab R2009a
%
%
*******************************************************************


% Press "F5" to run this script, please select correctly the COM
port.
```

```
% You should get a single sample from the iNEMO DLL with all data
sensors.


% To view all the methods of the iNEMO software component:
% libfunctions('iNEMO_SDK')
%
% or
%
% libfunctionsview('iNEMO_SDK')


% set up instance of iNEMO in MATLAB
%if (libisloaded('iNEMO_SDK'))
%  unloadlibrary('iNEMO_SDK');
%end


% Load the Dll within Matlab
[notfound, warnings] = loadlibrary('iNEMO_SDK.dll', 'iNEMO_SDK.h');


sCOM=input('What COM-port is your iNEMO connected to? <1>','s');


sCOM = strcat('PL_001:COM', sCOM, ', BD115200');


% Connect to iNEMO Board
%    Check i32 to manage errors
%          cs will return the sCOM string
[i32, cs] = calllib('iNEMO_SDK', 'INEMO_SDK_Connect', sCOM);
% Replace the previous instruction with the following in case you
receive
% an error on this row
%vp = libpointer('voidPtr', [int8(sCOM) 0]);
%[i32, cs] = calllib('iNEMO_SDK', 'INEMO_SDK_Connect', vp)


% Verify if iNEMO Board is Connected
%     Check i32 to manage errors (0 not connected, otherwise
connected)
% [i32] = calllib('iNEMO_SDK', 'INEMO_SDK_IsConnected')
```

```
% Request device information from iNEMO
%    Check i32 to manage errors (0 no error, otherwise code error)
%          cs will contain the string required
%          ip32 will contain the number of char returned
sVER = 'iNEMO String - Please do not delete this row';
[i32, cs, ip32] = calllib('iNEMO_SDK', 'INEMO_SDK_GetVersion',
sVER, 30);


% Replace the previous instruction with the following in case you
receive
% an erro on this row
%vp = libpointer('voidPtr', [int8(sVER) 0]);
%[i32, cs, ip32] = calllib('iNEMO_SDK', 'INEMO_SDK_GetVersion', vp,
30)


% Start Data Acquisition
%    Input: nFreq the acquisition frequency (Hz). Allowed values are
1, 10,
%                                                25, 50
%           nSamples number of samples to receive. Allowed range
value is
%                            0-65535; if 0 the device will send data
in
%                              continous mode until stop
%    Check i32 to manage errors (0 no error, otherwise code error)
nFreq = 10;
nSamples = 100;
[i32]= calllib('iNEMO_SDK','INEMO_SDK_Start', nFreq, nSamples);


% Initialize the FrameData Structure
pFD = struct('SampleTimeStamp',0, ...
    'Accelerometer',struct('X',0,'Y',0,'Z',0), ...
    'Gyroscope',struct('X',0,'Y1',0,'Y2',0,'Z',0), ...
    'Magnetometer', struct('X',0,'Y',0,'Z',0), ...
    'Pressure', 0, 'Temperature', 0);
```

```
% Add a 5% to the Time Acquisition interval (1/nFreq)
pauseDelay= 1.05/nFreq;

for i=1:nSamples
    pause(pauseDelay);
    % Get a data Sample, pFD is a pointer to FrameData_t structure
    %    Check i32 to manage errors (0 no errors, otherwise code
error)
    [i32, pFD] = calllib('iNEMO_SDK', 'INEMO_SDK_GetSample', pFD);

    % Show the Acquired Data
    disp(pFD.SampleTimeStamp);
    disp(pFD.Accelerometer);
    disp(pFD.Gyroscope);
    disp(pFD.Magnetometer);
    disp(pFD.Pressure);
    disp(pFD.Temperature);

end

% Stop Data Acquisition
%    It is mainly needed in case of Continous Acquisition
%    Check i32 to manage errors (0 no error, otherwise code error)
% [i32] = calllib('iNEMO_SDK', 'iNEMO_SDK_Stop');

% Disconnect iNEMO Board
%    Check i32 to manage errors (0 no error, otherwise code error)
[i32] = calllib('iNEMO_SDK', 'INEMO_SDK_Disconnect')

% when finished with iNEMO SDK, release it from the MATLAB workspace
% unloadlibrary('iNEMO_SDK')
```

# 4 Revision history

Table 1. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 18-Jan-2010 | 1 | Initial release. |

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